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Climate change and population declines in a long-distance migratory bird

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Supplementary information by *Both et al*: Climate change and population declines in a long-distance migratory bird

Table 1A: characteristics of the nest box study areas and the pied flycatcher populations using the nest boxes in the ten areas in the Netherlands that were used in the analyses.

Area	Data collector ¹	Longitude	Latitude	Number of nest boxes	Caterpillar peak date ²	Prop. of Great Tit Second broods ³	Maximum number of pairs ⁴	Population trend ⁵ (Slope \pm SE)		Proportional population change	Effect of temperature on laying date ⁶ (Slope \pm SE)	
Buunderkamp	NIOO-KNAW	05° 45' E	52° 01' N	260	57.5	0.12	93	-0.0284	0.005	-64%	-1.309	0.34
Deelerwoud	Dekhuyzen	05° 55' E	52° 05' N	200	57.5		110	-0.0025	0.004	-9%	-1.827	0.27
Ginkel	Stel & Van Laar	05° 45' E	52° 04' N	240	57.5	0.33	106	0.0052	0.003	+21%		
Hoge Veluwe	NIOO-KNAW	05° 51' E	52° 02' N	370	51.5	0.22	125	-0.0071	0.003	-23%	-1.929	0.32
Keppel	VWG Doesburg	06° 13' E	52° 00' N	54	37.5		11	-0.062	0.01	-90%		
Liesbos	NIOO-KNAW	04° 40' E	51° 35' N	102		0.07	9	-0.060	0.01	-89%	-0.41	0.57
Oldhorst	Vd Brink	05° 57' E	52° 27' N	84	39.5		26	-0.057	0.013	-88%	-0.806	0.38
Op de Bergen	Vd Brink	05° 50' E	52° 24' N	39	58.0		15	0.0035	0.003	+14%		
Staphorst	VWG Staphorst	06° 17' E	52° 37' N	1435	52.8	0.32	356	-0.0035	0.003	-12%	-1.672	0.27
Warnsborn	NIOO-KNAW	05° 51' E	52° 00' N	80	44.5	0.10	29	-0.0239	0.006	-59%	-1.263	0.37

¹ Data were collected by the Netherlands Institute of Ecology (NIOO-KNAW), two local bird groups (Doesburg and Staphorst) and individual amateur bird researchers.

² Caterpillar peak date for each area is the mean of the peaks in 2003 for two trees expressed as days after 31 March. The peak dates of the two trees within the same area were correlated: $r_s=0.74$, $n=9$, $p=0.02$. Data were available for 9 of the 10 study populations.

³ The proportion of great tits producing second broods in the years 1985-1990 (average of annual proportions). Second broods are laid after a successful first clutch has been raised, and thus prolong the breeding season.

⁴ The maximum number of breeding pairs in the nest boxes in the period 1987 -2003. In Liesbos the decline started some years earlier than 1987, and in 1984 there were still 17 pairs breeding in the area.

⁵ The slope (\pm SE) of the regression of the logarithm (to the base 10) of number of breeding pairs in nest boxes against year in 1987-2003.

⁶ The slope (\pm SE) of the regression of the annual median laying date against temperature for the period 16 April – 15 May (\pm SD of the slope) for the period 1980-2002. Data were available for 6 of the 10 study populations.

Justification for using caterpillar data from only 2003

We have data for all 9 of the study populations on the caterpillar peak from only 2003. However, this value should be representative of the entire study period because:

(1) the timing of the caterpillar peak differs consistently among sites within the same forest: seven sampling sites on the Hoge Veluwe, for which we have data for 1993-2004 differ consistently in the date of peak caterpillar biomass (site: $F_{6,65} = 17.52$, $P < 0.001$ correcting for year: $F_{11,65} = 22.35$, $P < 0.001$; Visser, M.E., Holleman, L.J.M. & Gienapp, P., 2006 Oecologia In Press). The mean within year difference in caterpillar peak date between the earliest and latest site in this area is 9 days, which is about half the difference of 20 days between the sites used in this study.

(2) the timing of the caterpillar peak differs consistently among areas: three widely-separated (30-150 km) forests in the Netherlands (of which only one (HV) had breeding pied flycatchers, the other two sites are Vlieland (53.17° N, 5.03° E) and Oosterhout (51.55° N, 5.50° E)) for which we have data for differ consistently in the date of peak caterpillar biomass (area: $F_{2,12} = 3.90$, $P = 0.049$; year: $F_{30,12} = 5.56$, $P = 0.0016$).